

HOLOCENE AND RECENT NON-MARINE MOLLUSCA FROM THE
NEIGHBOURHOOD OF PERRANZABULOE.

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Read 8th January, 1909.

THE following paper is work which my friend Mr. B. B. Woodward has wanted done for some time past. My opportunity came in November last, and, had the weather been more favourable, the result would have been probably more important.

The Church of Perranzabuloe was unearthed by storms in 1835, after being buried by 'blown sand' for nearly twelve centuries. The place was at once raided for building material and architectural relics, some of which are now in Truro Museum (Royal Institution of Cornwall). The ruins would give a date for anything of the nature of a Holocene deposit, but unfortunately there is none available for examination in the immediate vicinity. There were evidences for kitchen middens near it, as broken marine shells occur at a level 200 feet o.d. I found *Cardium rusticum* and broken fragments of *Mytilus edulis* near, and there were quantities found in 1835, supposed to be St. Piran's waste-heaps, but probably much older, if other evidences yet to be examined are found to belong to the late Bronze or early Iron age. Most of this shell deposit has been carted off by farmers as a fertilizer. The moss is very thick and wet on the lofty slopes of the hollow in which the ancient church lies, affording a suitable habitat for the species of Mollusca that are most moisture-loving.

The rediscovered church is about half a mile from the sea-cliffs, from which it is separated by deposits of shell-sand from 50 to probably 70 or 80 feet in depth, although as the sand dunes are deposited on the varying contours of the underlying Lower Devonian rocks, it is somewhat difficult to estimate their depth.

One of the most interesting points about the work has been the discovery of an old lacustrine deposit in which the Mollusca have been almost entirely of fresh-water species, with the exception of some examples of *Helix aspersa* and *Helicella virgata*, which may mark the former edge of the water, but this is not yet certain; they seem to have been blown into the water and then sunk to the bottom.

The shells indicated belong to a deposit formed on the bed of a shallow lake at about 200 o.d., which deposit overlies evenly stratified shell-sand, beneath which lies the slate rock. This stratified shell-sand is about 3 feet above the present surface, where it has been left, but unfortunately much of the deposit with its most valuable shell-evidence has been removed, and only the indurated sand has been left scattered about the site of the lake. This lacustrine deposit underlies part of the dunes of blown sand, which is 40 or 50 feet in thickness hereabout. The stormy wind fortunately scoops out

crater-like hollows in the looser sand, and exposes the lacustrine deposit at the bottom of the 'crater.'

H. aspersa, next to *Helicella barbara*, is the most noticeably abundant species. A large proportion have the light-brown periostracum so peculiar in Iberian specimens. *H. nemoralis* is not relatively so abundant and does not occur at the 200-foot level, but seems confined to some 'brambly' dunes at a level about 50 or 60 feet higher. There are very many thrush-killed *H. aspersa* and *H. nemoralis* lying on the surface here. *H. barbara* is abundant everywhere. The local name for these snails is 'sugar-loaves.' Mr. B. B. Woodward's *Helix nemoralis* zone, above the rubble-drift, occurs at the north cliff of Perranporth, overlain with many feet (4 to 7) of blown sand, in which *H. barbara* is abundant. Further work is needed round the coast-sections. Large specimens of the normal variety of *Arion ater* occur on the south cliff of Perranporth. A brown slug also occurred on the Re Sands, probably *Limax fulva*. The lacustrine Limnæas seem to contain very dwarfed forms of *Limnæa stagnalis* and *L. truncatula*, but some of the forms are so strangely unlike any modern Limnæas that they may be undescribed, or if not, certainly abnormal, species. The dwarfing of the species may be due to saline conditions, as Mr. B. B. Woodward suggests. It may be due to colder conditions than now obtain, just as the dwarfing of Canadian specimens of *L. jugularis* (identical with *L. stagnalis*) undoubtedly is. If further work proves this latter supposition to be correct, it will corroborate Mr. B. B. Woodward's most important paper in the Geological Magazine last year¹ as to the evidence of glacial conditions round Newquay, of which district Perranzabuloe and Perranporth are parts.

I. HOLOCENE.

A.—The shells which I found in the walls of the ruined church were
Vitrea radiatula, *Limax flavus*, *Limnæa pereger* (dwarfed form).

B.—(i) Those from the lacustrine area were—

Limnæa truncatula.

L. sp. (*a*), narrower and more elongated than *pereger*.

L. sp. (*b*), narrower and straighter than *pereger*.

L. stagnalis. Dwarf specimens.

L. pereger.

L. sp. (*c*), may be an abnormal *L. pereger*.

Helix aspersa. Undoubtedly belonging to this deposit, as they are in the same sub-fossil state.

H. nemoralis. All specimens from 200-foot level, stained with iron oxide, and with a thicker shell than recent specimens.

Helicella virgata. Two specimens (same remark as above as to their state, v. *H. aspersa*).

¹ "Drift and Underlying Deposits at Newquay, Cornwall": Geol. Mag., n.s., dec. v, vol. v, January and February, 1908.

- (ii) From the small piece of lacustrine deposit remaining in the 'sand crater' west of above deposit I obtained—

Limnæa truncatula (smaller dwarf form).

L. sp. (d); this may be *truncatula*, but has no umbilicus and no reflexion of the columella as is usual in that species.

- (iii) From the perpendicular section of stratified sand, and below the level of the small remnant of lacustrine deposit here at about 10 feet away to the eastward, I obtained at a depth of 4 to 7 feet—

Helicella barbara.

Vallonia pulchella.

V. excentrica.

Helix nemoralis (young).

H. aspersa (young).

Cochlicopa lubrica.

Jaminiæ muscorum.

J. cylindræa.

Limnæa pereger (young and very small).

C.—Recent shells or live specimens found in various parts were—

Vitrea radiatula. At foot of marram grass in 'crater.'

V. alliaria. Ditto.

Arion ater. Cliffs at Perranporth.

Helix aspersa. *Passim*.

H. nemoralis. In one spot only, 250 feet o.d.

Vallonia pulchella. Same habitat as *V. radiatula*.

V. excentrica. Ditto.

Helicella caperata. *Passim*.

H. virgata. *Passim*.

H. itala. *Passim*.

Jaminiæ cylindræa. At foot of marram grass in 'crater.'

J. muscorum. Ditto.

Cochlicopa lubrica. Not abundant.

Vertigo pygmæa.

Succinea elegans.

S. sp. (may be *S. oblonga*).

Limnæa (probably *truncatula*, dwarf form). Abundant among marram grass in 'crater.'

From the condition of some of these shells and the probable mixing up of Holocene and recent specimens by the action of the wind, it may be found that some of the shells in this list are not recent, though provisionally put therein. The fragment of lacustrine deposit at the base of the 'crater' is undoubtedly being destroyed by the wind, which cuts away the softer underlying sand and so causes the projecting shelf of lacustrine deposit to break off, very much as the recession of Niagara Falls is brought about by water action. The shells get detached from their matrix, and are then whirled up the sand-slope until stopped by the line of marram grass. Here the shells can be scooped up in thousands and examined afterwards at leisure.

TABLE OF SPECIES.

	Cliffs, Perran- porth.	St. Piran's Church (650 A.D. buried up).	Lacustrine deposit (Holocene).	Holocene Land Shells.	Recent.
<i>Arion ater</i> , Linn.	—	—	—	—	* 1
<i>Vitrea radiatula</i> , Alder . . .	—	—	—	—	*
<i>V. allivaria</i> , Müll.	—	—	—	—	*
<i>Vallonia pulchella</i> , Müll. . .	—	—	—	*	—
<i>V. excentrica</i>	—	—	—	*	—
<i>Cochlicopa lubrica</i> , Müll. . .	—	—	—	*	*
<i>Helicella itala</i> , Linn.	—	—	—	*	*
<i>H. caperata</i> , Mont.	—	—	—	—	*
<i>H. virgata</i> , Da C.	—	—	*	—	*
<i>H. barbara</i>	*	—	—	*	*
<i>Jamnia cylindracea</i> , Da C. . .	—	—	—	*	*
<i>J. muscorum</i> , Linn.	—	—	—	*	*
<i>Vertigo pygmæa</i> , Drap.	—	—	—	—	*
<i>Helix aspersa</i> , Müll.	—	—	*	*	*
<i>H. nemoralis</i> , Linn.	*	—	*	*	*
<i>Limnæa</i> sp.	—	—	—	—	—
<i>L. truncatula</i> , Müll.	—	—	*	—	—
<i>L. pereger</i> , Müll.	—	—	*	*	—
<i>L. sp. (a)</i>	—	—	*	—	—
<i>L. sp. (b)</i>	—	—	*	—	—
<i>L. sp. (c)</i>	—	—	*	—	—
<i>L. sp. (d)</i>	—	—	*	—	—
<i>Succinea elegans</i> , Risso . . .	—	—	—	—	*
<i>S. sp.</i>	—	—	—	—	*

Marine shells at 200 feet o.d. :

Cardium rusticum. Near St. Piran's Church.

Purpura lapillus. Edge of lacustrine deposit.

Mytilus edulis. Near St. Piran's Church.

It is my pleasant duty to thank Messrs. B. B. Woodward and A. Santer Kennard for help in determining critical species. They both think some of the fresh-water specimens require further study.

¹ Perranporth South Cliff.